

Docket : A.06-08-010  
Exhibit Number : \_\_\_\_\_  
Commissioner : Dian Grueneich  
Admin. Law Judge : Steven Weissman  
DRA Witness : House



**DIVISION OF RATEPAYER ADVOCATES  
CALIFORNIA PUBLIC UTILITIES COMMISSION**

**A.06-08-010**

**REPORT ON THE SUNRISE POWERLINK**

**San Diego Gas & Electric Company (SDG&E)**

**Phase 1 Direct Testimony  
Volume 5 of 5**

San Francisco, California  
May 18, 2007

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1    **1.    INTRODUCTION**

2

3    I am Lon W. House, Ph. D., Founder and President of Water and Energy Consulting. My  
4    resume is included as Appendix A to this Volume. I am addressing issues related to the  
5    availability of renewable resources in the Imperial Valley.

6

7    Access to the substantial renewable potential in the Imperial Valley is stated as one of  
8    rationales for the Sunrise Powerlink by SDG&E. It is also the reason for the policy  
9    recommendations of the state’s Integrated Energy Policy Report:

10

11            “To address ongoing transmission barriers to renewable development, the Energy  
12            Commission recommends:

- 13            • The California Public Utilities Commission should expedite processing of  
14            Certification of Public Convenience and Necessity applications for renewable  
15            transmission projects including the Antelope Transmission Project and Sunrise  
16            Powerlink project.”<sup>1</sup>

17

18    There are substantial renewable resources in the area, thousands of MWs of geothermal and  
19    solar, but current access to these resources is limited:

20

21            “Achieving these goals requires new and upgraded transmission  
22            infrastructure capable of delivering power from major renewable resource  
23            areas, including the Imperial Valley...”<sup>2</sup>

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<sup>1</sup> California Energy Commission, *2006 Integrated Energy Policy Report Update*, CEC-100-2006-001-CMF, January 2007, pg e-4.

<sup>2</sup> Report of the Imperial Valley Study Group, *Development Plan for the Phased Expansion of Transmission to Access Renewable Resources in the Imperial Valley*, September 30, 2005, p. 8.

1   **2.    GEOTHERMAL ANALYSIS**

2

3    An Energy Commission PIER Report estimates the amount of “economic” geothermal  
4    resources in the Salton Sea area at nearly 1,700 MW<sup>3</sup>, whereas another CEC report estimates  
5    that the “most likely” geothermal development potential to be 1,950 MW<sup>4</sup>. Similarly, the  
6    Governors Task Force Report identifies 1,300 MW in the Salton Sea/Brawley/Niland area<sup>5</sup>.

7

8    There has been significant development of the geothermal resource in this area. As Table 3-1<sup>6</sup>  
9    shows, over one-quarter of the resource potential has already been developed. There has not  
10   been voiced a credible criticism in this proceeding that the geothermal resource is not there,  
11   that the technology to utilize the resource does not exist, or that the resource will not be  
12   developed provided that there is a way to get the electricity from the Imperial Valley area to the  
13   load centers.

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<sup>3</sup> California Energy Commission, *New Geothermal Site Identification And Qualification*, CEC-P500-04-051, April 2004.

<sup>4</sup> California Energy Commission, *Renewable Resources Development Report*, P500-03-080F, November 2003, Appendix C-12.

<sup>5</sup> Western Governors Association Geothermal Task Force Report, Clean and Diversified Energy Initiative, January 2006.

<sup>6</sup> California Energy Commission, *California Geothermal Resources*, Staff Paper, CEC-500-2005-070, April 2005, page 8.

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3  
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TABLE 2-1

Estimates of Most Likely Geothermal Resource Capacity

Table 2: Most-Likely (MLK) Geothermal Resource Capacity

Geothermal Resource Area	County	MLK	Existing	MLK-
		MW	Gross MW	Existing MW
Brawley (North)	Imperial	135	0	135
Brawley (East)	Imperial	129	0	129
Brawley (South)	Imperial	62	0	62
Dunes	Imperial	11	0	11
East Mesa	Imperial	148	73.2	74.8
Glamis	Imperial	6.4	0	6.4
Heber	Imperial	142	100	42
Mount Signal	Imperial	19	0	19
Niland	Imperial	76	0	76
Salton Sea (including Westmoreland)	Imperial	1750	350	1400
Superstition Mountain	Imperial	9.5	0	9.5
	Imperial Total:	2487.9	523.2	1964.7

5

1 **3. SOLAR ANALYSIS**

2  
3 The Imperial Valley Study Group notes that Imperial County is estimated to have one-quarter  
4 of the state’s entire solar generation potential<sup>7</sup>. The PRE analysis lists potential solar in the  
5 area of 29,000 MW<sup>8</sup>, and substantial amounts of the solar resource in the area are already in the  
6 ISO analysis queue<sup>9</sup>.

7  
8 The value of access to the solar resource in the Imperial Valley, in particular to the solar  
9 generation provided by Stirling Energy Systems, Inc. (SES)<sup>10</sup>, is not accepted by all experts in  
10 this proceeding: “*Stirling Solar project is “bait and switch” - contract will fail and SDG&E*  
11 *will have a scapegoat”*<sup>11</sup>. If this is true, then much of the proposed benefit of Sunrise will  
12 disappear. Accordingly, an investigation of the commercial viability of the SES Project was  
13 undertaken.

14  
15 **3.1 Contract Terms and Provisions**

16  
17 The Power Purchase Agreement between SDG&E and SES was executed in September 2005  
18 and approved by the CPUC in Resolution E-3965 on December 1, 2005<sup>12</sup>. The contract calls  
19 for an initial phase of 300 MW with SDG&E options for two additional 300 MW phases for a

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<sup>7</sup> Report of the Imperial Valley Study Group, *Development Plan for the Phased Expansion of Transmission to Access Renewable Resources in the Imperial Valley*, September 30, 2005, p.8

<sup>8</sup> San Diego Regional Renewable Energy Group, *Potential for Renewable Energy in the San Diego Region*, August 2005.

<sup>9</sup> In addition to the 850 MW SCE contract and 900 MW SDG&E contract, SES is currently in the CAISO transmission queue for additional 3,150 MW (1,950 MW future expansion at Pisgah and 1,200 MW at Mohave) for a total of 4,900 MW in queue.

<sup>10</sup> There can be some confusion in nomenclature. “Stirling” is the technical name for the type of engine used in this technology, as well as in the name of the company that produces these solar generators.

<sup>11</sup> Presentation by Bill Powers, Border Power Plant Working Group, *Sempra’s Strategy and Alternatives to Sempra/SDG&E Sunrise Powerlink*, November 13, 2006, pg. 29.

<sup>12</sup> SES also has a CPUC approved contract with Southern California Edison (CPUC Resolutions E-3957, October 27, 2005). This contract has two phases, an initial 500 MW phase with an additional 350 MW phase. The SCE/SES contract is not linked to the SDG&E/SES contract – what happens with one of the contracts does not have any impact on the other contract.

1 total of up to 900 MW. The contract is a 20 year contract and “(D)eliveries from the power  
2 purchase agreements (PPAs) are priced below the 2004 market price referent (MPR) and thus  
3 do not require supplemental energy payments (SEPs) from the California Energy Commission  
4 (CEC).”<sup>13</sup>  
5

### 6 3.2 Experience 7

8 The Stirling solar dish technology has over 20+ years of research and development. The current  
9 SES power conversion unit (PCU) has over 158,000 hours (48 years equivalent) on-sun testing.  
10 The dish concentrator assembly has over 100,000 hours (30 years) on-sun experience. The  
11 complete system as an integrated unit has over 33,000 hours (10 years) on-sun experience.  
12

13 Sandia National Laboratories, through the Department of Energy, has provided technical  
14 support to the development of the dish-Stirling system since the late 1980s. There is currently  
15 an operating model power plant comprised of six SES dishes located at the National Solar  
16 Thermal Test Facilities at Sandia National Laboratories in New Mexico.  
17

### 18 3.3 Progress/Milestones 19

20 Construction of the first phase of 300 MW is anticipated from 2008 to 2010, with approximate  
21 two year construction periods thereafter for each additional 300 MW Phase. The first solar  
22 units are expected to start generating by 2010.  
23

24 The CAISO System Impact Study has been completed and indicates that 300 MW are available  
25 for this solar generation without new lines with implementation of a Special Protection Scheme  
26 for loss of a transformer bank at Miguel Substation. Access to the transmission system will be  
27 an approximately 8 mile gentie to Imperial Substation to be built by SES.

---

<sup>13</sup> California Public Utilities Commission, *Resolution E-3965*, December 1, 2005, page 1.

1 SES has signed agreements with suppliers of their various components and has a financial  
2 team, headed by Citigroup, in place. Appropriate land for the project has been identified and  
3 reserved and environmental reviews and permitting is ongoing.

4  
5 Based upon project schedule review, the SES project is on track for deliveries of power from  
6 the first phase of their project by 2010. While it is always possible that something unexpected  
7 could happen, there have been no significant impediments identified to date.

8  
9 *3.4 Issues*

10

11 Seals have historically been one of the technical challenges of the Stirling engine and design  
12 and leakage through the seals has been posited as a critical flaw in this system<sup>14</sup>. SES states  
13 that Kockums -- the people who developed the engine used in the SES system -- have spent a  
14 substantial amount of effort and money over the past 30 years improving the seals currently  
15 used. The seals in the SES system have an expected average service life in excess of 7,000  
16 hours, which is about 2 years in a solar operating mode. SES has assumed 6,000 hours between  
17 seal changes in their O&M assumptions, and claim that based on sensitivity studies, SES can  
18 stay within their total O&M cost budget with a replacement every 4,500 hours.

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<sup>14</sup> Presentation by Bill Powers, Border Power Plant Working Group, *Sempra's Strategy and Alternatives to Sempra/SDG&E Sunrise Powerlink*, November 13, 2006.

1   **4    LEARNING CURVE ANALYSIS**

2  
3   Since project milestones are currently being met, supplier agreements are in place, and there is  
4   significant experience with this technology, the question becomes: Will SES be able to meet  
5   their production quotas at their anticipated cost? For such an analysis, we turn to learning  
6   curve theory<sup>15</sup>.

7  
8   Learning curves, also known as experience curves, cost curves, efficiency curves, and  
9   productivity curves, illustrate how the cost per unit of output decreases over time as the result  
10  of increased volume of production. As cumulative output increases, learning and economies of  
11  scale cause the cost per unit to decrease. Learning curves are standardly used by businesses in  
12  production planning, cost forecasting, setting delivery schedules, and other applications.

13  
14  A learning curve is an industrial tool or formula representing the expected reduction of unit  
15  costs for large quantity production of components. The learning curve concept for industry  
16  states that the input cost (or time) per unit produced decreases by a set percentage every time  
17  the cumulative production output doubles. While the concept has been known since the 1800's,  
18  this price/quantity relationship was probably quantitatively used in the aerospace industry in  
19  1936 at Wright Patterson Airforce Base, where it was determined that every time that aircraft  
20  production doubled, the required labor time decreased by 10 to 15 percent. Subsequent  
21  empirical studies from other industries have yielded different values but have found that each  
22  time cumulative volume doubles, costs fall by a constant and predictable percentage. In the late  
23  1970s Bruce Henderson of the Boston Consulting Group Research recorded experience curve  
24  effects for various industries that ranged from 10 to 25 percent reductions<sup>16</sup>.

25  

---

<sup>15</sup> Purists in the field often differentiate between learning curves (to represent the reduction in the time and labor it takes to produce a product) and experience (or price experience) curves. Experience curves are broader in scope than the learning curve effect, encompassing far more than just labor time, and are used to represent the reduction in costs associated with greater production. However, for this discussion I will stick with the more common vernacular – learning curve – to represent both.

<sup>16</sup> Boston Consulting Group, *Perspectives on Experience*, 1972.

1 The most common form of the relationship between input per product is a power law function -  
2 a log-linear model in the form of:

3

4  $Y=AX^b$  Y equals A times X to the power of b

5

6 where:

7 Y = cost for the x<sup>th</sup> unit

8 X = cumulative number of units produced

9 A= input cost for the first unit

10 b = progress rate (defined the natural logarithm of the learning curve improvement  
11 percentage divided by the natural logarithm of 2)

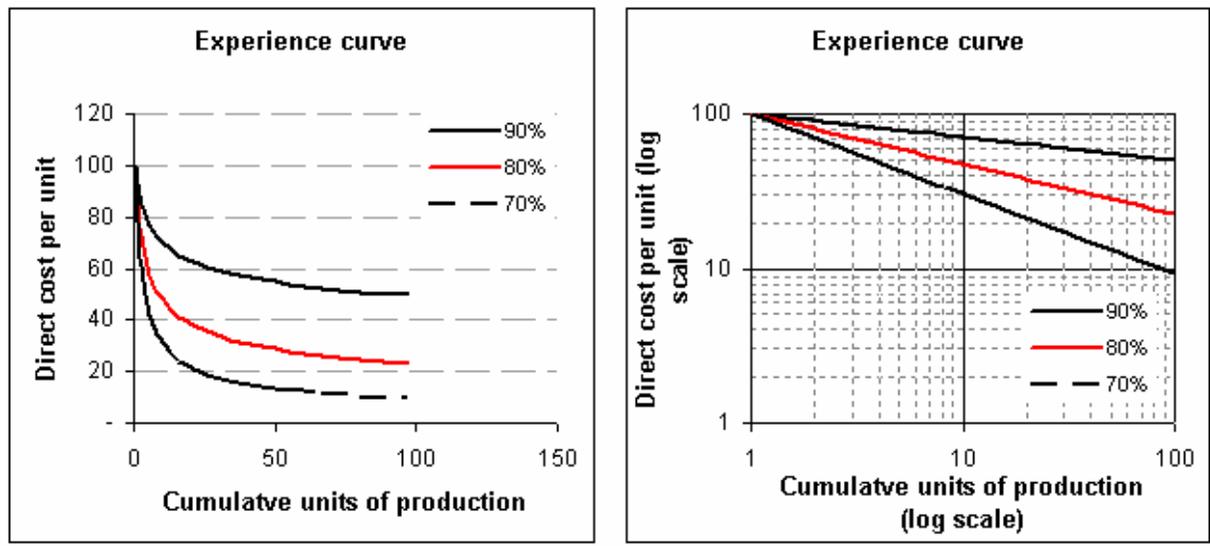
12 = (ln (“learning curve percent”) / ln(2))

13

14 The curve starts with a high cost per unit at the beginning of output, decreases quickly with  
15 increased volume, then levels out as cumulative output increases. As output doubles from one  
16 unit to two units to four units, etc., the learning curve descends quite sharply as costs decrease  
17 dramatically. As output increases, it takes longer to double previous output, and the learning  
18 curve flattens out. Thus, costs decrease at a slower pace when cumulative output is higher. The  
19 slope of the learning curve is an indication of the rate at which volume becomes transformed  
20 into cost savings.

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### FIGURES 4-1 and 4-2 Sample Learning Curves

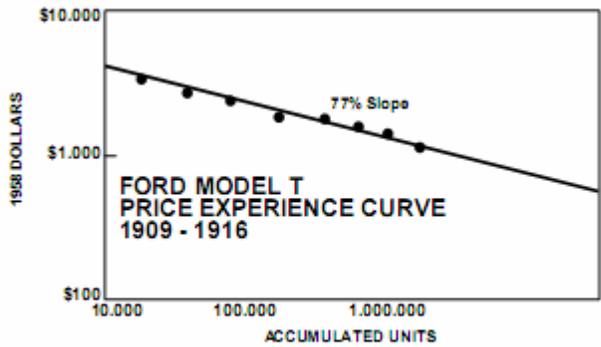


5  
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Source: [http://en.wikipedia.org/wiki/Experience\\_curve\\_effects](http://en.wikipedia.org/wiki/Experience_curve_effects)

8 An 80 percent learning curve (a 20 percent reduction in costs per doubling in cumulative  
9 production) has been used as a standard rule of thumb in many industries, and is sometimes  
10 used as an average in cost forecasting and production planning<sup>17</sup>. An 80 percent learning curve  
11 means that, for every doubling of output, the cost of new output is 80 percent of prior output.

<sup>17</sup> As a point of reference, Henry Ford experienced a learning curve of 77 percent on his Model T production from 1906-1916 (*Experience Curve Reviewed*, Perspectives 124, Boston Consulting Group, 1974).



Source: *Automobile Manufacturers' Association*

1 Although it should be cautioned that this can differ even for similar industries, within  
2 companies and for subsequent runs of the same product in the same plant, an 80 percent  
3 learning curve is often used as a default value.

1 **5. SES LEARNING CURVE ANALYSIS**

2

3 There are two types of learning curve analyses: a Unit Model and a Cumulative Average  
4 Model. The Unit Model approach does a learning curve analysis for each of the individual  
5 components of the system, whereas the Cumulative Average Model does a learning curve for  
6 the entire system. For this analysis both models were used – a Unit Model analysis was  
7 performed on major components of the SES system, and a Cumulative Average Model analysis  
8 was performed on the combination of these significant components<sup>18</sup>.

9

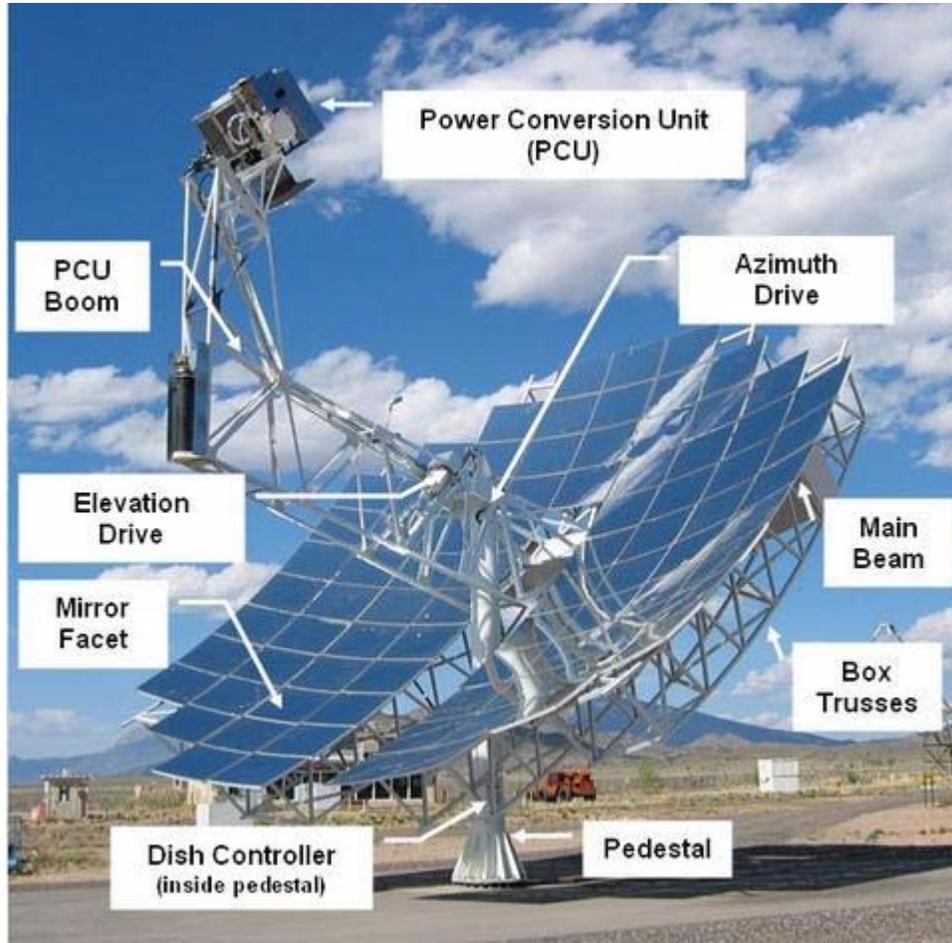
10 A picture of the Stirling Solar Generator with its components is provided in the following  
11 figure. The dishes are approximately 37 feet in diameter. Each dish generator produces 25 kW  
12 of power, tracking the sun throughout the day. The sunlight is reflected to the power  
13 conversion unit, which is a Stirling engine (closed cycle regenerative gas engine – also called  
14 external heat engine) that drives a 480-volt induction generator. The Stirling engine is a  
15 closed-cycle piston heat engine ("closed-cycle" means that the working gas is permanently  
16 contained within the engine, unlike the "open-cycle" internal combustion engines which  
17 exhaust to the atmosphere). A Stirling engine operates through the use of an external heat  
18 source and an external heat sink. The Stirling engine uses the potential energy difference  
19 between its hot end and cold end to establish a cycle of a gas expanding and contracting within  
20 the engine, thus converting a temperature difference across the machine into mechanical power,  
21 which is used to drive an electrical generator.

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<sup>18</sup> Learning curve analysis could not be conducted on the entire apparatus due to confidentiality issues.

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FIGURE 5-1  
SES Solar Generator



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7

8 The support structure is composed of a main (box) beam with 10 supporting trusses per dish.

9 To these are mounted the mirrored surface. SES has contracted the entire dish system to Schuff  
10 Steel – America’s largest steel fabricator.

11

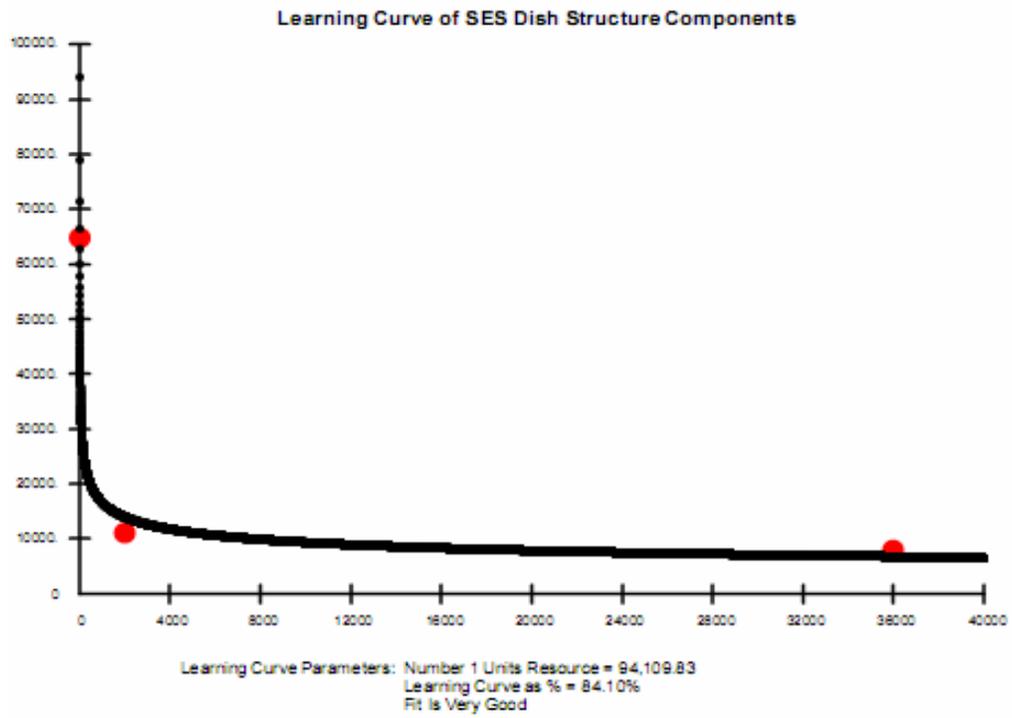
12 A learning curve analysis was conducted on SES volume and price estimates for the major

13 components of the dish support system: the structural components (the pedestal, main beam,

1 trusses, and boom that supports the power conversion unit) and the mirror facets. The results  
2 are shown below.

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FIGURE 5-2  
SES Solar Generator Dish Structure Components Learning Curve

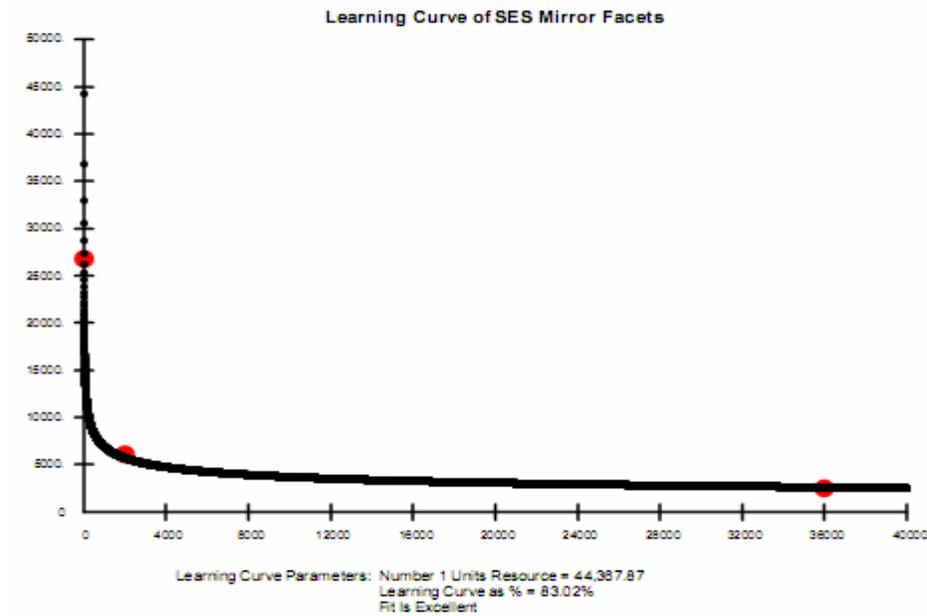


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FIGURE 5-3

SES Solar Generator Mirror Facets Learning Curve



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7 A picture of the power assembly can be seen in the following figure. The reflected sunlight is  
8 concentrated on the receiver. The internal side of the receiver (heater heads) heats hydrogen  
9 gas which expands inside the Stirling engine. The pressure created by the expanding gas drives  
10 a piston, crank shaft, and drive shaft assembly much like those found in internal combustion  
11 engines.

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FIGURE 5-4  
SES Power Conversion Unit



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8 As the following diagram shows, the engine is very similar to a standard automobile engine.  
9 The engine used in the SES system is a 35 hp (horsepower) engine. SES has been working  
10 with a major engine supplier to the Detroit auto industry, Linamar, since 1999 on these engines  
11 and has an agreement with them to produce the entire power conversion unit (including the  
12 Stirling engine, a generator, radiator cooling system, controls, etc).

13

14 A learning curve analysis was conducted on the major components of the power conversion  
15 unit that were unique to the Stirling engine: the heater head (4 quadrants of heat exchangers just  
16 behind the receiver), the regenerators (eight per dish)<sup>19</sup>, and the 480V electrical generator<sup>20</sup>.

17 These learning curves are presented below.

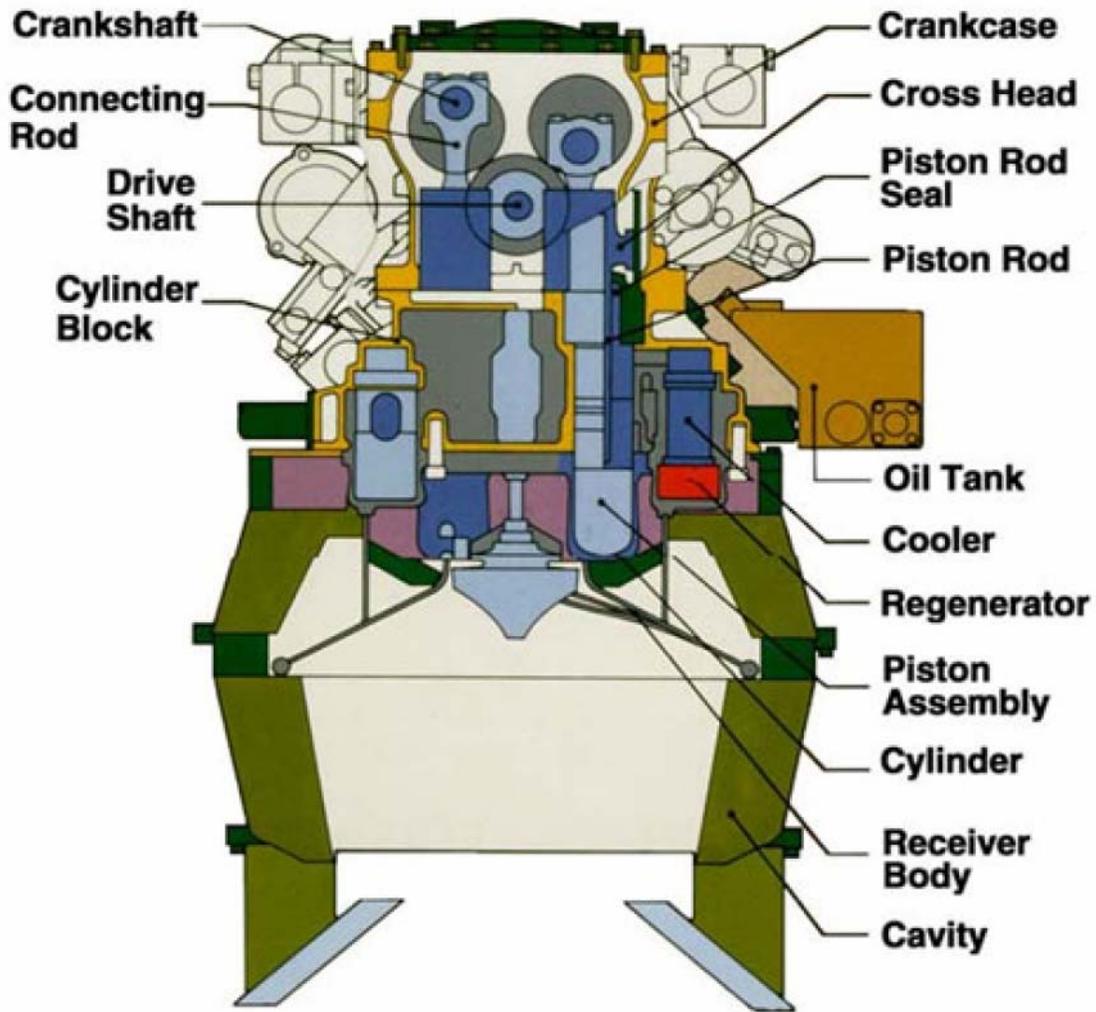
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<sup>19</sup> Regenerators capture residual heat from the hydrogen gas that has been heated and expanded (pushing pistons down) prior to the gas being actively cooled by the radiator system. On the next cycle, cooled hydrogen gas is compressed and then passed through the regenerator on its way to the heater head and pre-heated.

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FIGURE 5-5

SES Stirling Engine Diagram



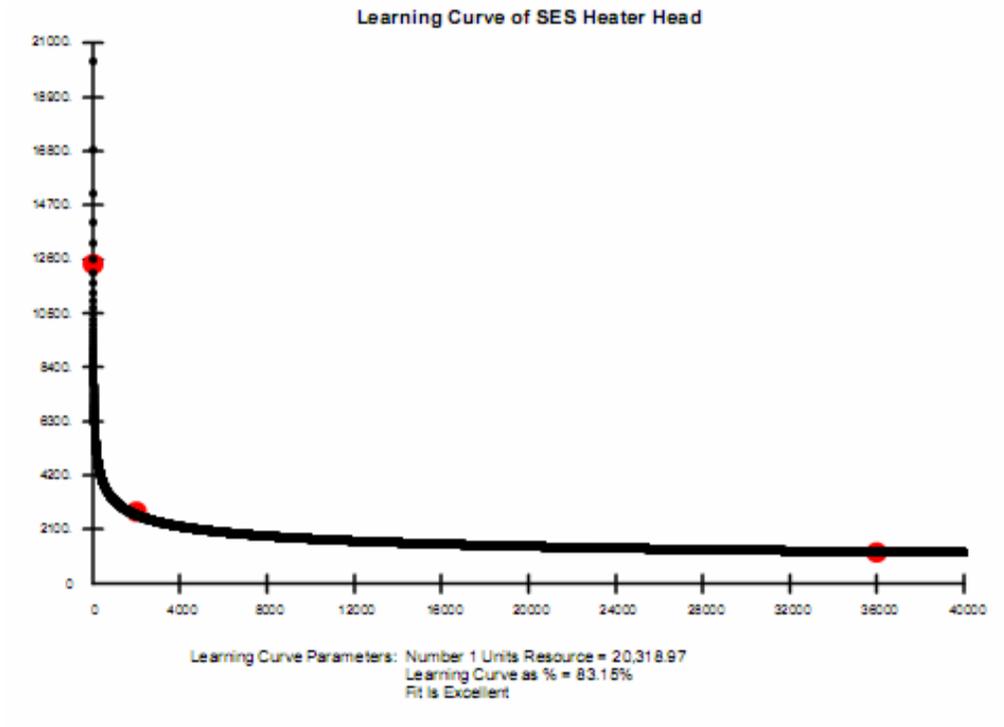
5

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<sup>20</sup> The generator is a fairly standardized component, but the SES had reduced the tolerances allowed and reduced the size of the usual generator.

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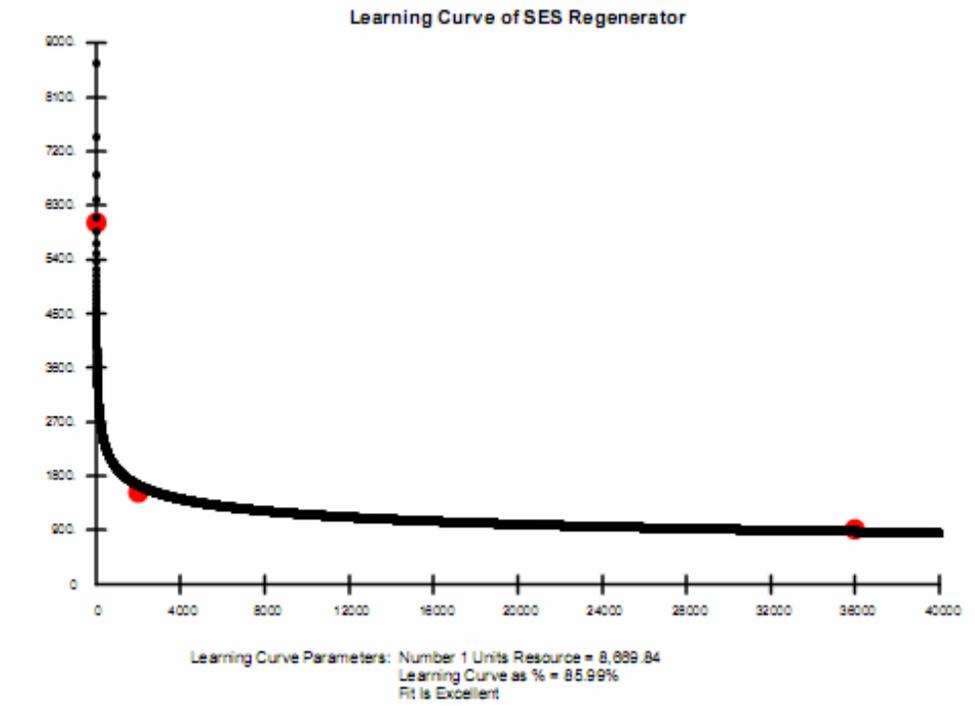
FIGURE 5-6  
SES Solar Generator Heater Head Learning Curve



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FIGURE 5-7  
SES Solar Generator Regenerators Learning Curve

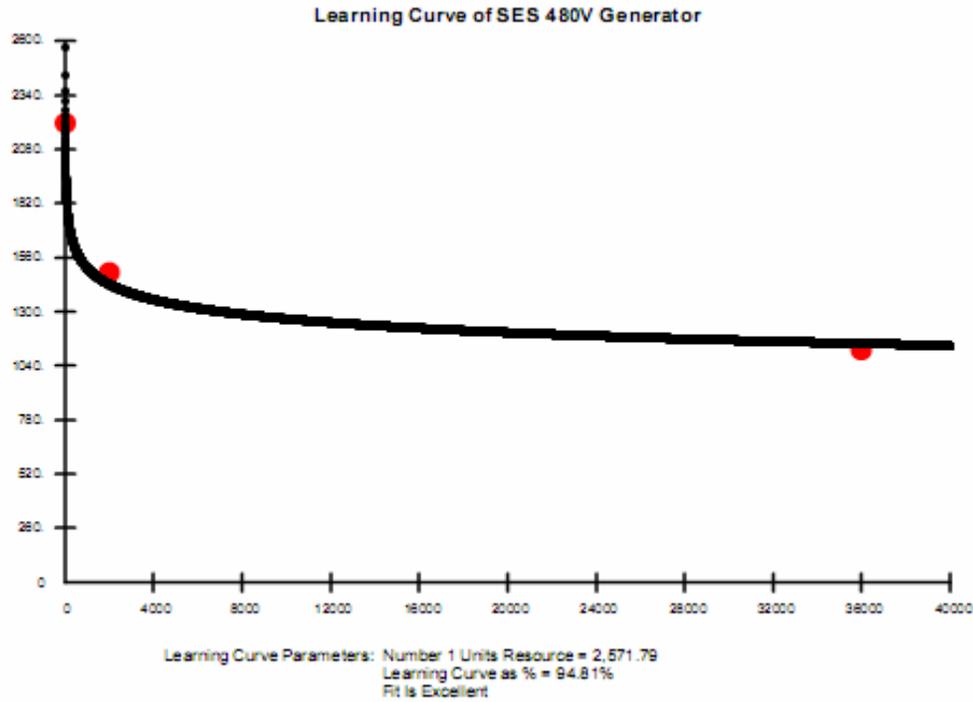


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FIGURE 5-8

SES Solar Generator 480 V Generator Learning Curve

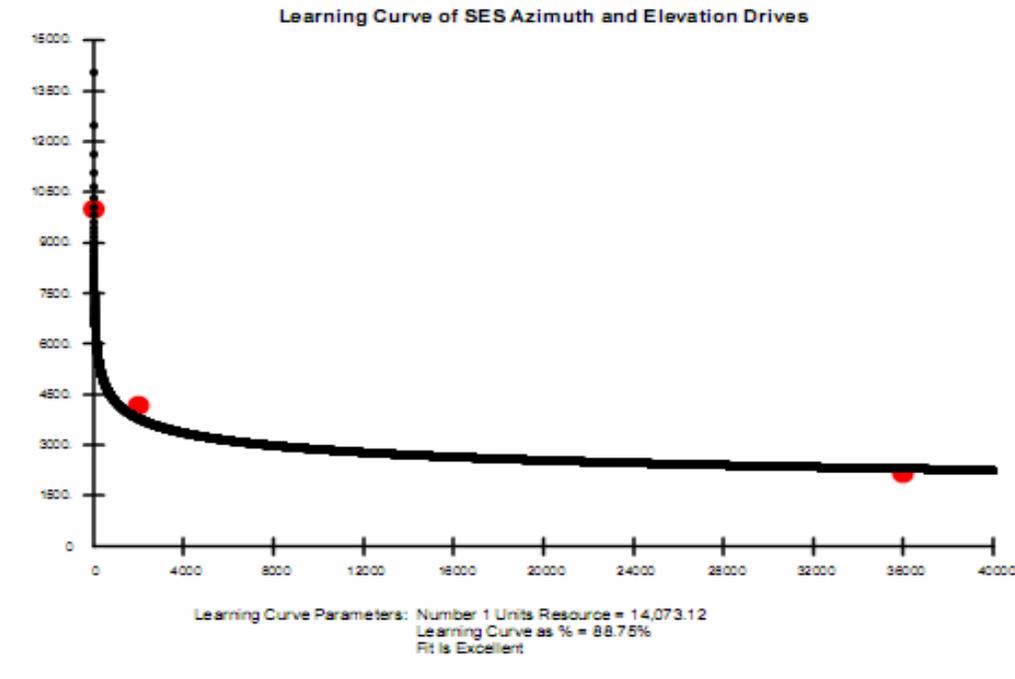


5  
6

7 The balance of the SES generator consists of the various controls and drivers necessary to make  
8 the solar generator operate. A learning curve analysis was conducted on the major balance of  
9 system components: the two drives (azimuth and elevation) and the electrical controls (PCU  
10 and dish controls, wiring harnesses, and sensors). The results are shown below.

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FIGURE 5-9  
SES Solar Generator Drives Learning Curve

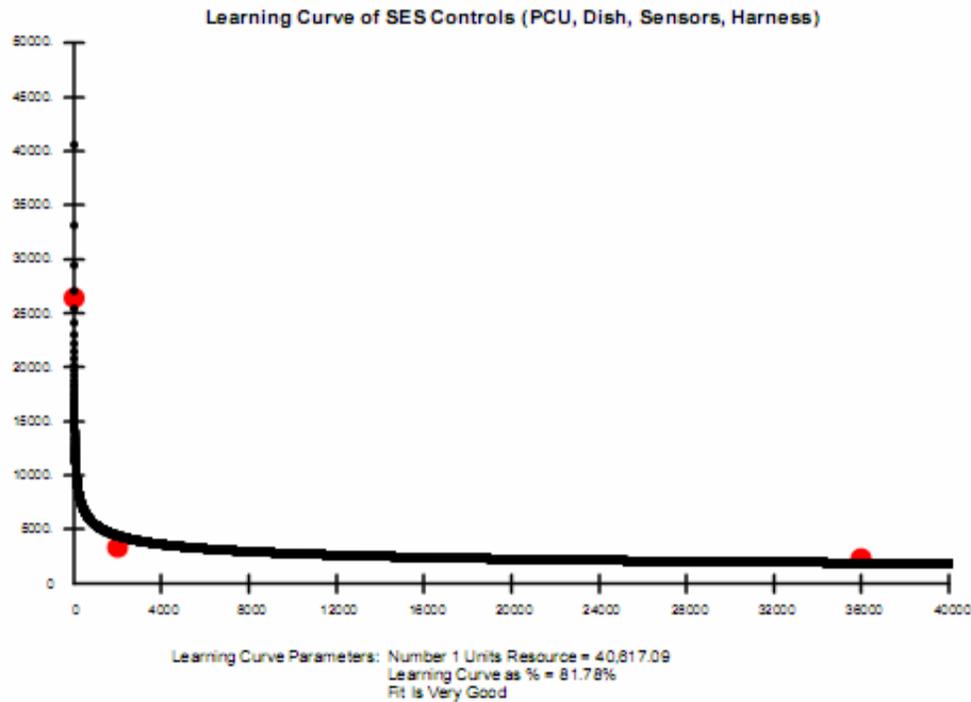


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FIGURE 5-10

SES Solar Generator Controls Learning Curve



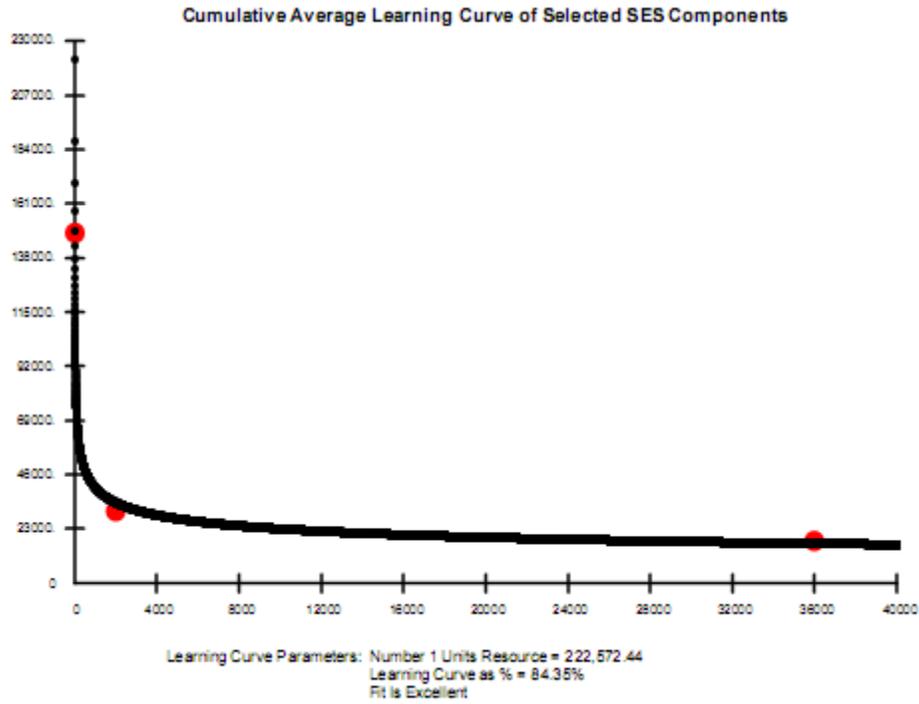
5  
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7 A comparison of the learning curve values for various components of the SES technology, as  
8 well as a Cumulative Average Model of these components is compared with values found in  
9 other industries in the Table 3-2 below. Note that the SES values are well within (and are  
10 actually more conservative than) the range of learning curve values from other industries. A  
11 Cumulative Average learning curve value of 84 percent means SES is projecting that costs will  
12 decrease an average of 16 percent for every doubling in output, a conservative estimate  
13 compared with experience in other industries.

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FIGURE 5-11

Selected SES Solar Generator Components  
Cumulative Average Learning Curve



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TABLE 5-1

Comparison of SES Learning Curve Values  
with Other Industry Values

<b>Table 3. Comparison of SES Learning Curve Values With Other Industry Values</b>			
<u>Industry</u>	<u>Learning Curve Value (1)</u>	<u>Industry</u>	<u>Learning Curve Value</u>
Aerospace	85%	Photovoltaics (2)	80%
Ship building	80-85%	Wind generators (2)	80%
Complex Machine	75-85%	Gas turbines (2)	80%
Machining / Punch Press	90-95%	FGD (fluidised gas desulfurisation) (3)	79%
Electrical Operations	75-85%	SCR (selective catalytic reduction) (3)	75%
Welding Operations	90%	Fluorescent lighting (4)	80%
Raw Materials	93-96%		
<u>Purchased parts</u>	<u>85-88%</u>		
<b><u>Sources:</u></b>		<b><u>SES Assumptions (5)</u></b>	
(1) NASA Cost Estimating Book, April 2002		Dish Structure (Pedestal, trusses, boom)	84%
(2) Robert Williams, Facilitating Widespread Development of Wind and Photovoltaic Technologies, Princeton Environmental Institute, February 2002		Dish Mirrors (82/generator)	83%
(3) "Experience curves for power plant emission control technologies", Int. J. Energy Technology and Policy, Vol. 2, Nos. 1/2, 2004.		Drives (Azimuth and elevation)	89%
(4) Daniel M. Kammen, Clean Energy & Leadership at the University of California, Renewable and Appropriate Energy Laboratory (RAEL), 2/24/2003		Controls (PCU, dish, sensors, harness)	82%
		Heater head (4 quadrants/engine)	83%
		Regenerator (8 per dish)	86%
		AC Generator (1/generator)	95%
(5) calculated		Cumulative Average Model	84%

6

1 **6. SES PROJECT CONCLUSION**

2

3 The analysis for the Stirling Energy Systems solar project in the Imperial valley shows they are  
4 within their milestone/progress schedule, the technology has had significant testing and  
5 exposure, they have agreements with the major component suppliers, and their expectations for  
6 costs for future components is well within industry standards. There is no reason, at this date,  
7 to expect that SES will not be able to obtain necessary permits and land access and supply  
8 sufficient quantities of solar generators at expected costs to meet their contract obligations with  
9 SDG&E.

## APPENDIX A

Qualifications of Lon W. House, Ph. D.

**LON W. HOUSE, Ph.D.**  
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## **SUMMARY**

Dr. House has extensive experience in utility negotiations and planning, energy procurement, resource planning, economic analysis, and with regulatory agencies. He has routinely provided policy directives and expert witness testimony. Dr. House has testified numerous times before the California Public Utilities Commission, California Energy Commission, California State Legislature, State Water Resources Control Board, State Board of Equalization, the California Power Authority, the California Independent System Operator, and the Federal Energy Regulatory Commission, as well as in numerous court cases. He has been the Association of California Water Agencies (ACWA) energy consultant since 1992, representing 500 water agencies which are responsible for over 90 percent of the water delivered in California; the Regional Council of Rural Counties (RCRC) energy advisor, representing 30 rural California counties encompassing over one-half of the land area of California; and has been an energy consultant to the Attorney General of the State of California. Dr. House also works for the California Public Utilities Commission as an expert witness, and for the California Energy Commission as a researcher.

Dr. House has a Bachelors, two Masters, and a Ph.D. in Human Ecology (Engineering and Economics) from U.C.Davis. He also has a CEM (Certified Energy Manager) certification and a Certified Sustainable Development Professional (CSDP) certification with the Association of Energy Engineers.

## **EDUCATION**

*Ph.D.* Human Ecology/  
Engineering & Economics University of California at Davis, 1982

*M.S.* Biology/  
Environmental Science Portland State University, 1978

*M.A.* Education/Science University of New Mexico, 1976

*B.S.* Biology/Geography University of New Mexico, 1974

## **CERTIFICATION**

Certified Energy Manager (CEM)  
Certified Sustainable Development Professional (CSDP)

## **EMPLOYMENT HISTORY**

1993 - present                      Founder and President  
Water and Energy Consulting

Dr. House provides expert witness testimony, regulatory representation, economic evaluations, policy directives, and planning functions for selected clients. Dr. House's clients include public agencies, trade organizations, regulatory agencies, and independent power producers. Dr. House is the energy consultant for the Association of California Water Agencies, representing 450 public water agencies and 50 mutual water companies in the areas of legislation, representation before regulatory agencies, and energy and economic analyses; is the energy advisor to the Regional Council of Rural Counties, representing 30 rural counties in California; and has been an energy consultant to the Attorney General of the State of California since 2004 and works for the California Public Utilities Commission as an expert witness, and for the California Energy Commission as a researcher

1990 - 1993                      Principal Consultant  
HES, Inc.

Dr. House was responsible for projects involving utility planning and analysis, energy regulation, economic assessments and modeling, rate design, and regulatory representation. Dr. House was also responsible for energy efficiency compliance analysis and was the lead technical person for Integrated Resource Planning and the evaluation and assessment of DSM (demand side management) in utility resource plans.

1986 - 1990                      Utility Resource Planner  
California Public Utilities Commission

While at the CPUC, Dr. House held the lead technical position for special projects. He was responsible for developing and coordinating team projects that involved modelers, engineers, economists, attorneys, and rate specialists. This assignment involved recommending policy positions to Commission management, preparing Commission reports, and presenting public testimony.

1983 - 1985                      Adjunct Lecturer - Department of Applied Science  
    College of Engineering  
    University of California at Davis

Dr. House taught upper division and graduate level courses in energy planning, energy modeling, energy generation technologies and options, energy policy, energy economics, and energy project financing.

1984-1986                      Public Utility Regulatory Program Specialist I  
    California Public Utilities Commission

While holding this position at the CPUC, Dr. House was responsible for detailed analysis of California investor-owned utilities' planning and operation. He was an operations and planning witness in general rate cases, energy cost adjustment clauses, certificates for public convenience and necessity, and special projects.

1981-1984                      Electric Generation Systems Specialist  
    California Energy Commission

While at the CEC, Dr. House performed analysis of utility production cost, system reliability, resource planning and finances. His efforts were concentrated in the areas of assessment of utility resource plans, evaluation of resource alternatives, utility operations, and financial evaluations.

1980-1981                      Energy Analyst  
    Technology Assessments Office  
    California Energy Commission

Dr. House analyzed economic, environmental, political and technical aspects of energy generation and conservation options while holding this position. This assignment included developing an analytical methodology for assessing energy conservation options and comparing them with generating resource options.

1979-1980                      Staff Scientist  
    Lawrence Berkeley Laboratory

Dr. House was responsible for the development of a macro-economic model that assessed the health and financial impacts of investments in utility generation and conservation technologies.

## **EXPERT TESTIMONY**

### Federal Energy Regulatory Commission

- "Motion To Intervene And Comments Of Water And Energy Consulting On Behalf Of Black Mesa Trust And To'Nizhoni Ani'" Docket No. ER04-316-000, January 14, 2004.
- "Regional Council of Rural Counties (RCRC) Comments on the FERC Hydroelectric Licensing Notice of Proposed Rulemaking RM02-16-000" Docket No. RM02-16-000, April, 2003.
- "Association of California Water Agencies (ACWA) Comments on the FERC Hydroelectric Licensing Notice of Proposed Rulemaking RM02-16-000" Docket No. RM02-16-000, April, 2003.
- "ACWA Comments on Standard Market Design" Docket Project No. RM01-12-000, November, 2002.
- "Motion to Intervene and Comments of the Regional Council of Rural Counties" Docket Project No. 77 et al., January, 2002.
- "Association of California Water Agencies (ACWA) Comments on Market Order Proposing Remedies for California Wholesale Electric System" Docket No. EL00-95-000, November 21, 2000.
- "Regional Council of Rural Counties (RCRC) Comments on Market Order Proposing Remedies for California Wholesale Electric System" Docket No. EL00-95-000, November 21, 2000.
- "The Association of California Water Agencies (ACWA) Motion to Intervene and Comments", Palm Springs Request for Wheeling, Docket No. TX96-7-000, March 27, 1996.
- "The Association of California Water Agencies (ACWA) Reply to PG&E Supplemental Comments", Stranded Cost NOPR, Docket No. RM94-7-001, February 27, 1996.
- "The Association of California Water Agencies (ACWA) Comments in RM 95-16-000", Hydro Relicensing NOPR, Docket No. RM95-16-000, January 5, 1996.
- "The Association of California Water Agencies (ACWA) Reply Comments in RM 95-8-000", Transmission NOPR, Docket No. RM 95-8-000, October 4, 1995.
- "The Association of California Water Agencies (ACWA) Comments in RM 95-8-000", Transmission NOPR, Docket No. RM 95-8-000, August 7, 1995.

- "Response to Proposed Rulemaking on Charges and Fees for Hydroelectric Projects", Docket No. RM 93-7-000, April 4, 1994.

#### State Water Resources Control Board

- "Testimony of Dr. Lon W. House"- Reconsideration of D.1644, Yuba River Water Rights Decision, June 5, 2003.
- "Impact of Bay-Delta Water Quality Standards on California's Electric Utility Costs", Water Quality Control Plan for the Bay-Delta Estuary, October 19, 1994.
- "Capacity, Production Cost, and Emissions Impact of Proposed Department of Fish and Game Temperature and Stream Flow Requirements on the Lower Yuba River" Lower Yuba River Hearing, February 10-13, 1992, filed January 21, 1992.

#### United States District Court For Northern California

- *People of California vs. Reliant Energy, et al.*, Expert Report of Lon W. House, Ph.D.
- "Environmental Regulations on California Merchant Power Plants: 2000-2001", case C-02-1788-VRW, April 2004.

#### State Board of Equalization

- "PG&E Petition for Reassessment of Unitary Value", Regional Council of Rural Counties, September 15, 2000.

#### San Joaquin Valley United Air Pollution Control District

- "Internal Combustion Engine BACT Permitting", September 8, 1998.

#### Superior Court of the State of California: County of Sacramento

- *California Sportfishing Protection Alliance v. State Water Resources Control Board, et al.*, "Declaration of Lon W. House in Opposition to Petitioner's Motion for Preliminary Injunction - Electricity Cost and Residual Emission Impacts of California Sportfisheries Protection Alliance Proposed Flows for the Lower Yuba River: December 1991 to October 1992", December 20, 1992.

Superior Court of the State of California: County of Humboldt

- *Fairhaven Power Company v. Pacific Gas & Electric Company*, "Assessment of Fairhaven Power Company's Claim for Capacity Payments from Pacific Gas and Electric Company for May 1992", April 1993.

California Public Utilities Commission

- A.05-06-006, et al., "Response to Utilities Joint Motion", November 2006.
- A.05-06-006, et al., "Proposals in Response to Commissioner Peevey's ACRs on Demand Response", September 2006.
- A.05-04-015/I,05-06-041, "Tipping Point Analysis and Attribute Assessment of DPV2", December 2005.
- A.05-06-006, et al., "Petition to Intervene and Rebuttal Testimony of the Association of California Water Agencies", October 2005.
- R.02-05-046, "Final Oral Arguments", December 2004.
- R.02-06-001. "Association of California Water Agencies (ACWA) Comments on Utility Filings Concerning Working Group 2 Programs and Related Issues", November 2004.
- R.02-05-046, "WEC Comments on Proposed Decision", November 2004.
- R.02-05-046, "Opening Brief", August 2004.
- R.02-05-046, "WEC Brief on TURN Confidential Exhibit (Exhibit #28C)", July 2004.
- R.02-05-046, "WEC Rebuttal Testimony in Response to March 9, 2004 ALJ Ruling", June 2004.
- R.02-05-046, "Water and Energy Consulting Concurrent Rebuttal", May 2004.
- R.02-05-046, "The Value And Impact Of Mohave And The Solar Option - WEC Supplemental Testimony in Response to March 9, 2004 ALJ Ruling", May 2004.
- R.02-05-046, "WEC Prehearing Conference Statement", February 2004.
- R.03-09-029, "Opening Comments of the Association of California Water Agencies", November 2003.
- R.02-05-046, "WEC Reply Supplemental Testimony", October, 2003
- I.02-04-026, "Joint Reply Brief Regarding Land Conservation Commitment and Environmental Stipulation", October 2003.
- R.02-05-046, "WEC Supplemental Testimony", October 2003.

- I.02-04-026, "The Association of California Water Agencies (ACWA) Rebuttal Comments", September 2003.
- I.02-04-026, "The Association of California Water Agencies (ACWA) Opening Comments on the Proposed Settlement", August 2003.
- I.02-04-026, "Joint Testimony of Lon House and Steve Rothert – Recommended Clarifications of the Land Conservation Commitment", Opening Comments of the Regional Council of Rural Counties, the Association of California Water Agencies, the California Hydropower Reform Coalition, and Environmental Defense, August 2003.
- I.02-04-026, "The Regional Council of Rural Counties (RCRC) Opening Comments", August 2003.
- A.02-05-046, "WEC Filing of Significant Additional Information", August 2003.
- A.02-05-046, "Water & Energy Consulting Briefing Testimony on Water Issues", July 2003.
- R.01-05-047, "The Regional Council of Rural Counties Supplemental Reply Brief on ALJ Terkeurst Ruling Setting Aside Submission and Requiring Additional Testimony", May 2003.
- A.02-05-046, "Water & Energy Consulting Concurrent Rebuttal Testimony", May 2003.
- R.02-06-001, "The Association of California Water Agencies Comments on Proposed Decision of Administrative Law Judge (ALJ) Carew", April 2003.
- A.02-05-046, "Water & Energy Consulting, Hopi, and Dine' Testimony", March 2003.
- R.02-06-001, "The Association of California Water Agencies Motion to Intervene And Comments on Working Group 2 Reports", December 2002.
- R.02-05-004, "Petition to Intervene of The Association of California Water Agencies (ACWA)", November 2002.
- R.02-05-046, "Petition to Intervene of Water and Energy Consulting for Local Hopi Sinom and Dineh People", November, 2002, and "Notice of Intent to Claim Intervenor Compensation of Water and Energy Consulting", November 2002.
- R.01-05-047, "The Regional Council of Rural Counties Reply Brief on Well Pumping Baseline Allowances", November 2002.
- R.01-05-047, "The Regional Council of Rural Counties Opening Brief on Well Pumping Baseline Allowances", October 2002.
- I.02-04-026, "The Regional Council of Rural Counties Reply Comments", May 2002.
- R.01-05-047, "The Regional Council of Rural Counties Testimony on Well Pumping Baseline Allowances", May 2002.
- R.01-05-047, "The Regional Council of Rural Counties Legal Brief on Threshold Issues – Can the Commission Include Other Variables in Baseline Determination", February 2002.

- A.98-07-003, "Association of California Water Agencies Comments on the Motion of Southern California Edison Company (U 338-E) To Immediately Implement Historic Procurement Charge And Related Testimony", January 2002.
- R.02-01-011, "Association of California Water Agencies Comments on the Draft Decision of ALJ Barnett Suspending Direct Access", January 2002.
- A98-07-003, A.98-07-006, A.98-07-026, "Response of the Association of California Water Agencies Utility Service Authority to Assigned Commissioner's Ruling That Direct Access Contracts And Agreements Be Submitted", December 2001.
- "Protest of Pacific Gas & Electric Company Advice Letter 2167-E and SDG&E Advice Letter 1369-E, Filed October 12, 2001", October 2001.
- A98-07-003, A.98-07-006, A.98-07-026, "Motion of The Association of California Water Agencies To Suspend Commission Consideration of Draft Decision Ending Direct Access In Light Of New Information", September 2001.
- A98-07-003, A.98-07-006, A.98-07-026, "Comments Of Laguna Irrigation District and ACWA-USA on Assigned Commissioner's Ruling Regarding Comments on Certain Direct Access Issues", September 2001.
- R.01-05-047, "The Regional Council of Rural Counties (RCRC) Testimony on Baseline Allowances", August 2001.
- A.00-11-038, "Comments of the Association of California Water Agencies on the Draft Agreement Between the Commission and the California Department of Water Resources" July 2001.
- A.98-07-003 , "Association of California Water Agencies Comments on the Proposed Decisions of ALJ Barnett and Commissioner Bilas", June 2001.
- R.00-01-005/R.00-11-038, "Regional Council of Rural Counties (RCRC) Motion to Intervene", June 2001.
- R.00-10-002, "Regional Council of Rural Counties (RCRC) Motion to Intervene and Testimony on Energy Division's Report on Interruptible Programs and Rotating Outages", February 2001.
- "RCRC Protest of Pacific Gas & Electric Company Advice Letter 2072-E, filed January 9, 2001 (Emergency Load Reduction Contingency Plan)", January 2001.
- "RCRC Protest of Pacific Gas & Electric Company Advice Letter 2053-E, Net Metering", November 2000.
- "ACWA Protest of Southern California Edison Advice Letter 1457-E ", June 2000.

- A.99-09-053, "Protest of the Association of California Water Agencies on the Application of Pacific Gas & Electric Company to Auction Hydroelectric Assets", October 1999.
  
- R.94-04-031/I.94-04-032, "Reply Comments of the Association of California Water Agencies on the Motion of the Independent Energy Producers et al. for an Order Approving PX based Pricing Pursuant to the One-time Election of Qualifying Facilities", September 1999.
  
- R.94-04-031/I.94-04-032, "Comments of the Association of California Water Agencies in Support of Motion of the Independent Energy Producers et al. for an Order Approving PX based Pricing Pursuant to the One-time Election of Qualifying Facilities", July 1999.
  
- A.98-05-022/A.98-05-014, "Testimony of the Association of California Water Agencies on Market Valuation of Retained Assets", March 1999.
  
- A.98-06-018, "Association of California Water Agencies Letter to Commissioner Duque", February 1999.
  
- A.98-05-022/A.98-05-014, "Prehearing Comments of the Association of California Water Agencies", January 1999.
  
- A.98-05-022/A.98-05-014, "Request of the Association of California Water Agencies for the Establishment of an Order Instituting Investigation/Rulemaking Regarding the Disposal of Utility Hydroelectric Assets and Associated Lands in the Deregulated California Electricity Market", December 1998.
  
- A.98-05-022, "Motion of the Association of California Water Agencies for Leave to File Late Comments on Pacific Gas and Electric Company's Proposed Scoping Memo and Ruling of Assigned Commissioner", November 1998.
  
- A.96-12-009, A.96-12-011, A.96-12-019, "Response of the Association of California Water Agencies to the Petition of New Energy Ventures for a Modification of Decision No. 97-08-056", February 1998.
  
- R.94-04-031/I.94-04-032, "ACWA Comments Proposed Decision of ALJ John S. Wong (R.94-04-031/I.94-04-032)", March 1996.
  
- R.94-04-031/I.94-04-032, "ACWA Comments on Utility Transition Cost Scoping Workshop in R.94-04-031/I.94-04-032", May 1996.
  
- R.94-04-031/I.94-04-032, "Comments on Report of the Interim PG&E Competition Transition Charge Collaboration", May 1996.

- R.94-04-031/I.94-04-032, "Proposed Methodology for Establishing an Interim Competition Charge for Pacific Gas & Electric Company", April 1996.
- R.94-04-031/I.94-04-032, "ACWA Comments on PG&E's Emergency Motion for Adoption of an Interim CTC Procedure to Departing Customers", February 1996.
- "ACWA Protest of PG&E Advice Letter 1561-E, Edison Advice Letter 1145-E, and SDG&E Advice Letter 977-E", February 1996.
- R.94-04-031/I.94-04-032, "ACWA Comments on PG&E's Emergency Motion for Adoption of an Interim CTC Procedure to Departing Customers", February 1996.
- R.94-04-031/I.94-04-032, "ACWA Petition for Modification of Decision 95-12-063", January 1996.
- R.94-04-031/I.94-04-032, "Association of California Water Agencies (ACWA) Comments on the MOU", October 1995.
- R.94-04-031/I.94-04-032, "Association of California Water Agencies (ACWA) Opening Comments on the Electric Industry Restructuring Proposals", July 1995.
- A.93-12-025/I.94-04-002, "ACWA Testimony on Proposed Edison Rate Schedule TOU-PA-3", Southern California Edison General Rate Case, June 1995.
- PG&E Advice 1498-E, "Protest of PG&E Advice Letter 1498-E (Proposed Schedule E-PS)", May 1995.
- A.93-12-029/I.94-04-003, "Brief of the Association of California Water Agencies", Southern California Edison Performance Based Ratemaking Proceeding, January 1995.
- A.84-06-014/A.85-08-025, "ACWA Protest of Division of Ratepayer Advocates' Petition for Modification of D.93-03-075", Diablo Canyon Pricing Mechanism, October 1994.
- R.94-04-031/I.94-04-032, "Comments of Eastside Power Association on the Need for Direct Access", Deregulation of Electric Utilities Proceeding, October 1994.
- A.93-12-029/I.94-04-003, "Review of Edison's Historic Rates and Prognosis for Future Rate Increases", Southern California Edison Performance Based Ratemaking Proceeding, September 1994.
- R.94-04-031/I.94-04-032, "Equity, Environmental, Public Policy Objectives in the Deregulation of California's Electric Utilities", Deregulation of Electric Utilities Proceeding, June 1994.

- R.94-04-031/I.94-04-032, "Deregulation of California's Electric Utilities: Comments and Observations", Deregulation of Electric Utilities Proceeding, May 1994.
- I.89-07-004/I.90-09-050, "ACWA Comments on Motion for *Ex Parte* Order for Award of Final Standard Offer 4 Contracts", Biennial Resource Plan Update, May 1994.
- Docket I.D. E19054, "ACWA's Second Set Of Comments on Electric Services Industry", August 1993.
- "Comments on Regulatory Reform and Ratemaking for the California Electric Utilities" Division of Strategic Planning Comments Phase, March 1993.
- A.91-11-036, "Reply Brief of the Association of California Water Agencies - Electric Rate Design" Pacific Gas and Electric Company General Rate Case, Test Year 1993, December 1992.
- A.92-04-001, "Prepared Testimony of Lon W. House on Pacific Gas and Electric Company's IER, O&M Adder, and ERI for Forecast Year 1993", Pacific Gas and Electric Company 1993 Energy Cost Adjustment Clause, July 1992.
- R.91-08-003/I.91-08-002, "Comments on BRPU Avoided Costs to be Used to Evaluate DSM", Demand-Side Management Order Instituting Investigation/Rulemaking, October 1991.
- A.89-07-004, "Uncertainty Associated With Significant Reliance on DSM" in "Prepared Testimony of Henwood Energy Services, Inc." Biennial Resource Plan Update Proceeding, September 1991.
- A.89-07-004, "Gas Bias of FSO4" and "Critique of SDG&E's Proposal" in "Prepared Testimony of Henwood Energy Services, Inc." Biennial Resource Plan Update Proceeding, September 1990.
- A.88-12-035, "Resource Planning and Production Cost Impacts", Southern California Edison Company Proposal to Merge with San Diego Gas and Electric Company, February 1990.
- A.88-12-005, "Energy Resources Policy and System Modeling Report for the Pacific Gas and Electric Company General Rate Case: Test Year 1990", February 1989.
- A.88-04-057, "Forecast Report-Pacific Gas and Electric Company Energy Cost Adjustment Clause", June 1987.

- A.86-12-047, "Analysis of Demand Side Management Programs for the Southern California Edison Company General Rate Case: Test Year 1988", May 1987.
- A.82-04-044, (et al), "Testimony of the Public Staff Division on Utility Resource Plans", Consolidated Proceedings for the Revision of Long and Short-Run Standard Offers, April 1987.
- A.86-07-041, "Analysis of 1987 Residential Conservation Financing Program of Southern California Edison Company", Edison General Rate Case, November 1986.
- A.85-12-050, "Long Run Marginal Cost", Pacific Gas and Electric Company 1987 General Rate Case, April 1986.
- A.82-04-044 "Prepared Testimony of the Public Staff Division", Phase II of the Proceeding to Develop a Long Run Standard Offer for Cogenerators and Small Power Producers, January 1986.
- A.82-04-044, "Modeling, Assumptions, and Implementation of Methodology", Phase I of the Proceeding to Develop a Long Run Standard Offer for Cogenerators and Small Power Producers, June 1984.

#### California Power Authority

- "Association of California Water Agencies Comments on the Draft Energy Resource Investment Plan of the California Consumer Power and Conservation Financing Authority", February 8, 2002.

#### California Energy Commission

- Docket #04-IEP-1H, "ACWA Comments on Water-Energy Relationship", June 2005.
- Docket #04-IEP-1H, "Summary of the Association of California Water Agencies Energy Committee Meeting and Discussion with The California Energy Commission", April 2005.
- Docket #04-IEP-1H "Demand Response Potential", April 2005.
- Docket #04-IEP-1H, "Water-Energy Relationships", January 2005.
- Docket #03-IEP, "Committee Hearings on Scope of 2005 Integrated Energy Policy Report", August 2004.

- Docket #02-IEP-01, "California Hydroelectric Background Information", June 2003.
- Docket #02-IEP-01, "Comments of The Regional Council of Rural Counties (RCRC) On *Draft Comparative Cost of California Central Station Electricity Generation Technologies*", February 2003.
- Docket #99-CEO-1, "Comments of the Association of California Water Agencies and the Association of California Water Agencies Utility Service Agency on Assessment of Supply Adequacy in California", October 1999.
- Docket #96-REN-1890, "Association of California Water Agencies Comments on Committee Draft Guidelines for the Renewable Technology Program for Hearing December 11, 1997", December 1997.
- Docket #96-REN-1890, "Association of California Water Agencies Comments on Staff Draft of the Guidebook for the Renewable Technology Program for Hearings October 16, 1997", October 1997.
- Docket #96-REN-1890, "Association of California Water Agencies Comments on Committee Draft Policy Report on AB 1890 Renewables Funding", February 1997.
- Docket #96-REN-1890, "ACWA Comments for Commission Hearing on Renewables Certification Criteria", November 1996.
- Docket #96-REN-1890, "Comments on En Banc Commission Hearing on Renewables", October 1996.
- Docket #93-ER-94, "ACWA Comments in Response to the October 11 Committee Order on Policy Analysis - Deregulation of the Electric Utilities in California", October 1993.
- Docket #90-ER-92, "Demand-Side Management Uncertainty", February 1992.
- Docket #90-ER-92, "Uncommitted Demand-Side Management Assumptions and Projections", November 1991.
- Docket #90-ER-92, "DSM Evaluation Methodology and Verification Needs", October 1991.
- Docket #87-ER-7, "Iterative Cost Effectiveness Resource Plan Methodology", November 1989.

- Docket #85-CFM-5, "Minimum Oil and Gas Generation Levels in California Utilities", June 1984.
- Docket #83-CFM-5, "Avoided Cost Methodologies Illustrated", April 1984.

## **PROFESSIONAL AND TECHNICAL SOCIETIES**

Association of Energy Engineers - Senior Member  
Sigma Xi - The National Research Honor Society  
Institute of Electrical and Electronics Engineers (IEEE) - Power Engineering Society  
American Association for the Advancement of Science – Senior Member

## **RECOGNITION**

Who's Who Among Young Men in the West - 1988  
Who's Who in Science and Engineering - Second Edition, Fourth Edition  
International Directory of Distinguished Leadership – 1994  
Who's Who in Natural Gas/Power

## **REPRESENTATIVE UTILITY CLIENTS**

Florida Power and Light - Evaluation of Purchase of Hydroelectric Assets  
Modesto Irrigation District - Value and Allocation of Stranded Costs  
Imperial Irrigation District - Deregulation Planning, Evaluation of Contract Options  
Eastside Power Association - Transmission Addition Evaluations, Negotiations  
American Electric Power - Analysis of Dynamic Operating Costs  
Central and South West Services - Integrated Resource Planning  
Pacific Gas and Electric - Compressed Air Energy Storage Evaluation, Wind Generation  
Impacts on Utility Operation  
San Diego Gas and Electric - Compliance with Air Pollution Emission Requirements  
Northern California Power Agency - Integrated DSM/Supply-side Bid; Evaluation of  
DSM Programs  
Cajun Electric Cooperative - Strategic Planning  
Central Louisiana Electric - Operation of a Jointly Owned Generation Facility

## **REPRESENTATIVE PRIVATE CLIENTS**

Attorney General: State of California – Energy Expert in Antitrust Cases Against Generators  
Regional Council of Rural Counties - Energy Advisor, Regulatory Representation  
Association of California Water Agencies (ACWA) - Energy Consultant, Regulatory

Representation, Advisor to the ACWA Utility Service Agency  
California Public Utilities Commission - Evaluation of Utility Generation Options, expert witness  
California Energy Commission - researcher

Energy Storage Partners - Regulatory Representative, Power Marketing

Friant Power Authority - Utility Negotiations, Due Diligence

Expert Witness: Mitchell, Dedekam & Angell,  
Law Offices of Daniel F. Gallery,  
Bartkiewicz, Kronick & Shanahan,  
Law Offices of Beatrice Snider

**PUBLICATIONS/ARTICLES** - A list is available.

## PUBLICATIONS/ARTICLES

“*Water Supply Related Electricity Demand in California*”, Demand Response Research Center/California Energy Commission, Lawrence Berkeley National Laboratory, LBNL-62041, December 2006.

*Will Water Cause the Next Electricity Crisis?* in Water Resources Impact, Vol. 9, No. 1, January 2007. Published by American Water Resources Association.

(With M. Henwood and D. Branchcomb), *A Strategy for Least Cost Utility Operations in Light of the Clean Air Act: Consideration of Emissions Costs in Commitment and Dispatch Decisions*, Proceedings of Power-Gen '91, December 1991.

A Utility Resource Planning Primer, California Public Utilities Commission, Division of Ratepayer Advocates, April 1989.

(With other authors), Report to the California Legislature on the Implementation of Assembly Bill 475 (1985): Production Cost and Financial Planning Computer Models Used by California Utilities, California Public Utilities Commission, December 1986.

Minimum Oil and Gas Generation Levels in California Utilities, California Energy Commission, P300-82-015, 1985.

*Using Production Cost Models to Predict Emissions from Utility Power Plants: A Case Study*, Air Pollution Control Association Proceedings, January 1985.

*Progress of Wind Energy Developments in California*, Alternative Energy Sources VI, Vol. 3, 1985.

*Avoided Cost Payment Options: Which is Best for Windfarms?*, Wind Power Digest, Summer 1984.

*Windfarm Avoided Cost*, California Energy Commission News and Comment, Fall 1983.

*Reliability Impacts of Wind-Generated Electricity on California Utilities*, Reliability of Power Systems, Institute of Electrical Engineers, September 1983.

*The Integration of Wind and Solar Technologies into the Electric Utility Grid: A Review of the Issues*, The Renewable Challenge, American Institute of ISES, June 1982.

(With E. Amir), *Economic Assessment of Geothermal Plant Efficiency Improvements in the PG&E System*, Proceedings of the Geothermal Resources Council Annual Meeting, October 1982.

(With E. Amir and P. Gertner), Economic Assessments of Residential Retrofit Electricity Conservation Measures: Consumer and Utility Perspectives, California Energy Commission, P300-81-024, 1981.

Wind and Solar Electricity Producing Technologies Impact on Electric Utilities, California Energy Commission, P300-81-024, 1981.

(With other authors), Environmental Assessment for Consumer Products Efficiency Standards Program, U.S. Government Printing Office, DE/CS/20315-T1, 1980.